

WHAT IS CLAIMED IS:

1. A fuel reforming apparatus comprising:
 - a vaporizing device that produces a vapor by vaporizing at least a portion of a first one of a hydrocarbon fuel and water, without mixing with a second one of the hydrocarbon fuel and the water, so as to produce a vapor gas containing the vapor and air;
 - a vapor mixing device that receives the vapor gas from the vaporizing device, and creates a vapor mixture by spraying at least a portion of at least one of the hydrocarbon fuel and the water, which was not vaporized by the vaporizing device, toward the supplied vapor gas; and
 - a reforming device that receives the vapor mixture from the vapor mixing device and reforms the hydrocarbon fuel to a reformate gas containing hydrogen.
2. A fuel reforming apparatus according to claim 1, wherein:
 - the vaporizing device vaporizes at least a portion of the water; and
 - the hydrocarbon fuel is a liquid, and the vapor mixing device sprays the hydrocarbon fuel.
3. A fuel reforming apparatus according to claim 2, wherein the vapor mixing device includes a spray device that controls a spray quantity of the hydrocarbon fuel.
4. A fuel reforming apparatus according to claim 3, wherein:
 - the vaporizing device is supplied with air;
 - the vaporizing device vaporizes the water and produces the vapor gas using the supplied air;
 - the vapor mixing device is supplied with a gas selected from the air and the vapor gas, via the spray device; and
 - the vapor mixing device creates the vapor mixture by spraying the hydrocarbon fuel with the spray device using the selected gas.
5. A fuel reforming apparatus according to claim 1, wherein the vapor mixing device includes a spray device that sprays and controls a spray quantity of the at least a portion of the at least one of the hydrocarbon fuel and the water.
6. A fuel reforming apparatus according to claim 5, wherein:
 - the vaporizing device is supplied with air;

the vaporizing device vaporizes the hydrocarbon fuel and produces the vapor gas using the air;

the vapor mixing device is supplied with a gas selected from the air and the vapor gas, via the spray device; and

5 the vapor mixing device creates the vapor mixture by spraying the water with the spray device using the selected gas.

7. A fuel reforming apparatus according to claim 5, wherein the spray device sprays a plurality of liquids, so as to spray at least a portion of both the hydrocarbon fuel and the water.

10 8. A fuel reforming apparatus according to claim 5, wherein the spray device includes a return member that returns a portion of the hydrocarbon fuel which is not vaporized to a supply, and a return quantity adjusting device that adjusts a quantity of the hydrocarbon fuel returned to the supply by the return member.

9. A fuel reforming apparatus according to claim 5, wherein the spray device uses a gas when spraying the at least a portion of the at least one of the hydrocarbon fuel and the water.

10. A fuel reforming apparatus according to claim 9, wherein the spray device uses at least a portion of the vapor gas produced by the vaporizing device as the gas.

20 11. A fuel reforming apparatus according to claim 5, wherein the spray device sprays the water.

12. A fuel reforming apparatus according to claim 1, wherein the vapor mixing device includes a vapor gas supply quantity adjusting device that adjusts a quantity of the vapor gas supplied by the vaporizing device to the vapor mixing device.

25 13. A fuel reforming apparatus according to claim 1, wherein the vapor
mixing device includes an air supply quantity adjusting device that adjusts a quantity of
the air supplied to the vapor mixing device.

14. A fuel reforming apparatus according to claim 1, further comprising a vapor spray quantity controller that controls a quantity of the one of the hydrocarbon fuel and the water supplied to the vaporizing device, and a quantity of the at least a portion of the at least one of the hydrocarbon fuel and the water supplied to the vapor mixing device.

15. A fuel reforming apparatus according to claim 14, wherein the vapor spray quantity controller controls a temperature of the vapor mixture supplied to the reforming device so that the vapor mixture falls within a predetermined temperature range.

5 16. A fuel reforming apparatus according to claim 15, wherein the predetermined temperature range contains a temperature that is below a lower limit of a regular operating temperature range of the reforming device by a predetermined amount.

10 17. A fuel reforming apparatus according to claim 1, wherein the vapor mixing device includes a mixture promoting member that promotes mixture of the vapor gas, a gas supplied to the vapor mixing device, and the sprayed liquid.

15 18. A fuel reforming apparatus according to claim 17, wherein:
the mixture promoting member is substantially conical with a through hole in a center thereof; and

15 19. the vapor mixing device includes the mixture promoting member and a supply port such that the supplied vapor gas and air are mixed and spurted out from the through hole, and sprays the at least a portion of the at least one of the hydrocarbon fuel and the water from the through hole of the mixture promoting member.

20 19. A fuel reforming apparatus according to claim 1, wherein the hydrocarbon fuel is gaseous, and the water is supplied to the vaporizing device.

20 20. A fuel reforming apparatus comprising:
a vaporizing device that vaporizes water and produces a vapor gas that includes the vaporized water and air;

25 21. a vapor mixing device, to which a gaseous hydrocarbon fuel is supplied, and that creates a mixed gas by spraying water using one selected from air, the vapor gas, and the gaseous hydrocarbon fuel, toward the supplied hydrocarbon fuel; and

25 22. a reforming device that receives the mixed gas from the vapor mixing device and reforms the gaseous hydrocarbon fuel to a reformate gas containing hydrogen.

30 21. A fuel reforming method comprising the steps of:
producing a vapor gas by vaporizing at least a portion of a first one of a hydrocarbon fuel and water, without mixing with a second one of the hydrocarbon fuel

and the water, the vapor gas containing air and the vaporized first one of the hydrocarbon fuel and water;

creating a vapor mixture by spraying at least a portion of at least one of the hydrocarbon fuel and the water, which was not vaporized, toward the vapor gas;

5 and

reforming the hydrocarbon fuel to a reformate gas containing hydrogen using the vapor mixture.

22. A method according to claim 21, wherein:

at least a portion of the water is vaporized; and

10 the hydrocarbon fuel is a liquid, and the hydrocarbon fuel is sprayed in the creating step.

23. A method according to claim 22, wherein a spray quantity of the hydrocarbon fuel is controlled.

24. A method according to claim 21, wherein the hydrocarbon fuel is 15 gaseous, and the water is vaporized.